COURSE DESCRIPTION CARD - SYLLABUS

Course name
Virtual prototyping in control engineering [S2AiR2-ISA>WPwAP]

Course

Field of study
Automatic Control and Robotics

Year/Semester
1/1

Area of study (specialization)
Intelligent Control Systems

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

dr hab. inż. Konrad Urbański
konrad.urbanski@put.poznan.pl

Lecturers

Prerequisites

A student beginning this course should have knowledge of automation and robotics corresponding to level 6 of the Polish Qualification Framework, in particular knowledge of the basics of automation, the theory of linear dynamic systems and programming skills. They should also understand the need to broaden their competences and be ready to cooperate in a team.

Course objective

To familiarize students with different programming environments for modeling and simulating dynamic objects in the context of rapid prototyping of control systems. To present the basic functions and capabilities of selected programming environments. Presentation of how to use different object modeling methods in their own programs. Introduction to selected methods of simulation time optimization and parameter selection methods.

Course-related learning outcomes

Knowledge:
has a structured and in-depth knowledge of modelling and systems identification; has knowledge of development trends and the most significant new achievements in the field of automation and robotics

and related scientific disciplines

Skills:
can simulate and analyse the operation of complex automation and robotics systems and plan and perform experimental verification; can critically evaluate and select appropriate methods and tools to solve a task in automation and robotics; can use innovative and unconventional tools in automation and robotics;

Social competences:
understands the need for and knows the opportunities of continuous learning - improving professional, personal and social competences, can inspire and organise the learning process of others;

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Lecture: end of semester colloquium
Laboratory: current checking of skills within the framework of realized tasks in the field of creating models of objects and control structures

Programme content

Simulation and modeling environments for mechatronic systems
Control, analysis and visualization tools using ROS (Robot Operating System).

Course topics

Computational functions and analysis of results of Matlab environment and selected modules of Python language
Optimization tools in Matlab and in selected Python language modules
Use of specialized libraries in programming and simulation environments
Implementation of artificial neural network calculations in different environments, transfer of ANN structures, shallow and deep networks
Basic operations and Python language packages in modeling and simulation
Isolated virtualenv/virtualenvwraper environment for Python language
Introduction to the Docker containerization environment
Using the Gazebo simulator to model mechatronic systems
Use of ROS (Robot Operating System) for communication and control of mechatronic systems.

Teaching methods

Lectures:
Lecture with multimedia presentation (including: drawings, photos, animations, sound, films) supplemented by examples given on the board
Lecture conducted in an interactive way with formulation of questions to a group of students
Presentation of a new topic preceded by a reminder of related content known to students from other subjects

Laboratories:
- working in teams
- computational experiments

Bibliography

Basic:
1. Internet tutorials for the current version of the Python 3.x language
2. Documentation (internet) of selected Python language packages for version 3.x
3. Documentation (internet) of GazeboSim for a specific version
4. Documentation (internet) of ROS for a specific version
5. Documentation (internet) of Docker
6. Online tutorials and knowledge base branded by MathWorks ®.

Additional:

1. Modelowanie matematyczne systemów, J. Gutenbaum, Wyd. 3 rozsz. i popr. Warszawa: Exit 2003
2. Modelowanie i symulacja układów i procesów dynamicznych, Stanisław Osowski, Warszawa 2007
3. Ćwiczenia z automatyki w Matlabie i Simulinku, Jerzy Brzózka, Wydawnictwo EDU-MIKOM, Warszawa 1997
4. MATLAB The Language of Technical Computing, The Math Works, Inc., (wydanie od 2008r.)
5. Automate the Boring Stuff with Python, A. Sweigart, latest edition
6. Python: wprowadzenie, M. Lutz, Helion, wydanie jak najnowsze
7. Python dla każdego. Podstawy programowania, M. Dawson, wydanie jak najnowsze

Breakdown of average student's workload

	Hours	ECTS
Total workload	105	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	45	1,50